

Radio-Frequency and Microwave (RFMW) Radiation and Fields (30 kHz to 300 GHz)

Los Alamos National Laboratory
Laboratory Implementation Requirements LIR 402-400-02.0
Issue Date: 01/30/97

1.0 Introduction

Lessons Learned: **Note:** [Click here](#) for Lessons earned *that may apply* to the requirements contained in this LIR.

1.1 Overview

The Laboratory conducts research and development programs that involve sources of radio-frequency and microwave (RFMW) nonionizing electromagnetic radiation. Devices that may produce RFMW radiation include telecommunications and radar equipment; industrial equipment, such as radio-frequency heaters; and scientific and medical equipment, such as magnetic resonance imagers and klystron tubes. Exposure to RFMW radiation is regulated under Department of Energy Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards." This document falls under Director's Policy DP106, "Occupational Health and Safety Management."

The document for personnel exposure adopted by the Department of Energy (DOE) is based on the safety levels for radio-frequency radiation established by the Institute of Electrical and Electronics Engineers (IEEE) in IEEE C95.1(1991), "Electromagnetic Fields, Safety Levels with Respect to Human Exposure to Radio Frequency."

This LIR complements the expectations contained in LPR 402-00-00, App. 15.

See Attachment B (Guidance) for Recommended Major Implementation Criteria for Self-Assessment.

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2.0 Purpose

This Laboratory document defines the scope of the RFMW protection plan that each line organization at the Laboratory must develop. It also describes Laboratory documents and other support resources that may be used to develop these plans.

3.0 Scope

3.1 Applications This Laboratory document establishes requirements for controlling the exposure of Laboratory personnel and the public to nonionizing electromagnetic radiation and fields with frequencies from 30 kHz to 300 GHz. These requirements apply to all Laboratory personnel, contractors and subcontractors, visiting scientists, and any other personnel who conduct operations involving sources of RFMW energy.

On the effective date, this document replaces administrative requirement (AR) 5-1, "Radio-Frequency/Microwave (RFMW) Radiation and Fields (30 kHz to 300 GHz)," and technical bulletin 502, "Guidelines for Measuring Exposures from Radio-Frequency/Microwave (RFMW) Radiation and Fields (30 kHz to 300 GHz)."

3.2 Exemptions The following items are exempt from the RFMW exposure limits; however, their manufacture is subject to federal RFMW emission standards:

- cellular phones,
- two-way hand-held radios and walkie-talkies that emit less than 7 W between 10 kHz and 1 GHz,
- microwave ovens used for heating food, and
- video display terminals.

Contact the Industrial Hygiene and Safety Group (ESH-5) for additional information on exemptions.

4.0 Definitions

4.1 Acronyms The following acronyms are used in this document. Some are further defined in Sec. 4.3, "Terms."

DD—division director

EM—electromagnetic (see Sec. 4.3)

ESH—Environment, Safety, and Health Division

ESH-2—Occupational Medicine Group

ESH-5—Industrial Hygiene and Safety Group

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MPE—maximum permissible exposure (see Sec. 4.3)

MW—microwave

PD—program director

RF—radio frequency

RFMW—radio frequency and microwave

SI—International System of Units

SOP—standard operating procedure

4.2 Symbols and Units

The following symbols and units of measure are used in this document.

A—ampere

B—magnetic flux density, measured in T or G

E—electric field strength, measured in V/m

f—frequency, measured in Hz

G—gauss

H—magnetic field strength, measured in A/m

Hz—hertz, cycles per second

kg—kilogram

m—meter

S—equivalent power density in mW/cm²

T—tesla

V—volt

W—watt

4.3 Terms

The following terms are used in this document.

Note: The definitions below for far and near fields apply to simple sources of radio-frequency and microwave (RFMW) radiation (such as radar dishes) and are provided as a general guideline. These definitions may not be accurate for complex or irregularly shaped sources (such as scientific apparatus). Separate measurements of both the electric and magnetic fields should be made until it is certain that one is well outside the near field before relying on a single probe. A single probe is used only when the electric and magnetic fields are proportional, that is, the ratio of the two remains constant through space.

averaging time—The time period over which exposure is averaged for determining compliance with a maximum permissible exposure (MPE) limit.

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4.3 Terms (cont.)

contact current—Transient discharges caused when contacting an energized object.

controlled environment—Locations where exposure to radio-frequency or microwave radiation (RFMW) is incurred by employees who are aware of the potential for exposure as a concomitant of employment.

duty factor—The fraction of time a transmitter or source is emitting radio-frequency or microwave (RFMW) energy, usually expressed as the ratio of the time on to the sum of the time on and off during the averaging time. For continuous emitters, the duty factor is equal to 1. The duty factor is multiplied by the field measurement to obtain a time-averaged exposure.

electric field strength—The electric field strength, E , is a vector quantity that represents the force, F , on a positive test charge, q , at a point divided by the charge ($E = F/q$). Electric field strength is expressed in terms of a voltage gradient with units of volts per meter (V/m).

electromagnetic (EM) radiation—The transmission of energy through space in wave form, which can be characterized in terms of a wavelength and a frequency. Electromagnetic energy consists of an electric field and a magnetic field oscillating in unison.

induced body current—Currents induced in an individual during exposure to radio-frequency electromagnetic fields. The human body behaves as an antenna in which currents are induced by the surrounding electric field. The induced currents flow in the body through the trunk and legs to ground.

magnetic field strength—The force with which a magnetic field acts on an element of current situated at a particular point. Magnetic fields can be referred to in terms of two vector quantities: magnetic flux density, B , or the magnetic field strength, H . The literature pertaining to extremely-low-frequency (ELF) radiation typically uses magnetic flux density, and the radio-frequency (RF) community uses magnetic field strength. The SI unit for flux density is the tesla (T). Another commonly used unit for flux density is milligauss (mG), where $1 \mu\text{T} = 10 \text{ mG}$. In contrast, the RF community expresses field strength in terms of amperes per meter (A/m). Field strength and flux density are related by the following equation:

$$1 \text{ A/m} = 12.57 \text{ mG} \quad .$$

maximum permissible exposure (MPE) limit—An exposure limit or guideline for radio-frequency and microwave (RFMW) energy exposure published by the American National Standards Institute (ANSI).

nonionizing radiation—A general term used if the energy of electromagnetic radiation is incapable of either directly or indirectly producing ions or ionized molecules.

plane wave power density—Although most radio-frequency and microwave (RFMW) exposure standards are written in terms of E and H fields, it is sometimes convenient to express field strength in terms of the equivalent plane wave power density, S , in milliwatts per square centimeter (mW/cm^2).

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4.3 Terms (cont.)

power density— Power per unit area normal to the direction of propagation, usually expressed in terms of watts per square meter (W/m^2) or milliwatts per square centimeter (mW/cm^2).

pulse-modulated field—An electric field produced by the amplitude modulation of a continuous-wave radio-frequency or microwave (RFMW) carrier signal at a known repetition rate with a controlled duty factor.

radio-frequency and microwave (RFMW) radiation—The portion of the electromagnetic spectrum from 30 kHz to 300 GHz. Frequencies from 300 MHz to 300 GHz are also referred to as microwave radiation.

regulated area—The space surrounding a radio-frequency or microwave (RFMW) radiation source that has the potential to emit radiation at a level equal to or greater than one-half the exposure limit for the specific frequency. (One-half the exposure limit is the safety margin adopted by the Laboratory to ensure adequate nonionizing radiation protection.)

uncontrolled environment—Locations where radio-frequency or microwave (RFMW) exposure is incurred by individuals (employees or the public) who may have no knowledge of or control over their exposure.

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5.0 Responsibilities

5.1 Owning Program Director or Division Director

The owning program director (PD) or division director (DD) has responsibility, accountability, and authority for assigned facilities and processes and is ultimately responsible for developing a radio-frequency and microwave protection plan for controlling the exposure of Laboratory personnel and the public to nonionizing electromagnetic fields with frequencies from 30 kHz to 300 GHz associated with the work conducted in those facilities and processes. Line managers and facility managers act as agents of the PD or DD. It is incumbent upon the owning PD or DD to establish the appropriate authorities of these agents to ensure that this document is effectively implemented within his or her area of responsibility.

5.2 Line Managers and Facility Managers

Line managers and facility managers, acting as agents of the owner PD or DD must, unless otherwise stated,

- ensure development of a written, site- or facility-specific, radio-frequency/microwave (RFMW) protection plan, which can be a standard operating procedure (SOP), for their organization, facility, or activity that addresses the objectives stated in the next section;
 - request from the Industrial Hygiene and Safety Group (ESH-5) a written variance from any requirements in this document when compliance cannot be achieved because of the age or configuration of the facility;
 - identify RFMW workers within their organization or facility;
 - assist ESH-5 in conducting any RFMW surveys within their organization or facility; and
 - provide necessary training to workers within their organization or facility.
-

5.3 ESH-5

ESH-5 has the following responsibilities:

- Identify unreported RFMW sources through site inspections and by reviewing documents such as SOPs and purchase records.
 - Evaluate areas and sources to determine RFMW radiation and field levels and employee exposures.
 - Report results of RFMW radiation and field evaluations to line managers and affected employees.
 - Assist operating groups to determine control measures, where necessary, and to evaluate control measures.
 - When requested, provide training assistance, information, and advice about RFMW radiation and fields.
 - Maintain required records (see Sec. 8.2)
-

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5.4 ESH-2

ESH-2 has the following responsibilities:

- Provide consultation to employees with cardiac pacemakers or similar medical devices about work in areas with elevated RFMW radiation and fields.
 - Ask ESH-5 to investigate physician or patient concerns about RFMW radiation and fields.
 - Maintain required records (see Sec. 8.3)
-

5.5 Employees

Employees have the following responsibilities:

- Follow all SOPs, SWPs, rules, and regulations for working in areas with elevated RFMW radiation and fields.
 - Cooperate with ESH-5 personnel to ensure that valid and representative sampling data are collected.
-

6.0 Precautions and Limitations

This document is a general interpretation of relevant laws and standards and does not address all conceivable situations. Contact ESH-5 for any specific situations and for exceptions to the requirements found in this document. Any suggestions involving changes in the requirements or concerns over their interpretation should be referred to ESH-5.

7.0 Standard Requirements

7.1 Objectives of the RFMW Protection Plan

The goals of each organization's site-specific RFMW plan must be to minimize exposure of employees to RFMW radiation and to achieve the limits established in Attachment A, "RFMW Exposure Limits." To achieve these goals, the following objectives must be met:

- ensure that all sources of RFMW radiation are contained in the site-specific RFMW plan and provided to ESH-5 for the inventory database;
- ensure that Laboratory-adopted RFMW standards referenced in Sec. 9.0 are met;
- ensure that workers are provided adequate job-specific training;
- ensure the control of RFMW sources through engineering, work-practice, and administrative controls; and
- ensure that the workplace is adequately monitored to determine compliance with limits specified in Attachment A.

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7.2 RFMW Exposure Protection Limits

The Laboratory-adopted exposure limits in Attachment A are discussed in Secs. 7.8 and 7.9. These exposure limits specify a maximum permissible exposure (MPE) limit in terms of electric field, magnetic field, power density, and induced and contact currents. MPEs are specified for both controlled and uncontrolled environments. Uncontrolled environments are regulated more strictly because individuals have no knowledge of or control over their exposure.

The Laboratory-adopted exposure limits, which limit the specific absorption rate of RFWM nonionizing energy to below 0.4 W/kg, are established to minimize health effects associated with tissue heating.

7.3 Medical Requirements

Employees with medical implant devices (such as cardiac pacemakers) who work in a regulated area must be referred to the Occupational Medicine Group (ESH-2) to ensure that their device is properly shielded.

Owning PDs and DDs must ensure (through their line managers, facility managers, or supervisors) that employees who are involved in an actual or suspected overexposure are referred to ESH-2 for medical review against nonionizing radiation guidelines.

7.4 Periodic Review

ESH-5 must periodically evaluate sources of RFWM radiation and submit a written report. The frequency of evaluation is at the judgment of the ESH-5 industrial hygienist, who may also use the ESH-5 NIR prioritization algorithm. As agents of the owning PDs or DDs, line managers and facility managers will assist in the evaluation and will notify ESH-5 in a timely manner if there is any new source or change in existing sources with respect to frequency of operation, source power, or configuration that could change the exposure potential. ESH-5 must perform a reevaluation in a timely manner at the request of the line managers, facility managers, or employees.

7.5 Safety Training

Employees who routinely work in or enter regulated areas as determined by line managers must be provided with job-specific training as appropriate to meet hazard communication requirements. The owning PD or DD is responsible for ensuring that this training is provided and may call ESH-5 or ESH-13 for assistance. All training must be documented in accordance with Laboratory procedures. This training may be included in the certification process for an SOP covering the use of static magnetic field sources.

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7.6

Limiting Personnel Exposure

Acting as agents of the owning PDs and DDs, line managers and facility managers are responsible must ensure that exposures of personnel to RFMW radiation do not exceed applicable levels specified in Attachment A. ESH-5's surveys will include recommendations for controls that line managers and facility managers must consider.

7.7

Control Measures

Engineering controls must be the primary method for restricting exposure whenever practical. Work-time limits, based on the averaging intervals specified in Attachment A, and other work-practice and administrative controls must be used if engineering controls are not practical. Control measures are discussed in order of preference below.

7.7.1. Lockout Program. Operating groups must develop procedures to prevent devices from producing unnecessary radiation while equipment is being serviced. Personnel must lock out and tag out equipment according to Laboratory procedure LP106-01.2, "Lockout/Tagout for Control of Hazardous Energy Sources for Personnel Safety (Red Lock Procedure)," and Laboratory procedure LP106-02.1, "Lockout/Tagout for Control of Equipment and Systems Status (Blue Lock Procedure)."

7.7.2. Interlocks. Chamber- or oven-type equipment that uses microwave radiation must have interlocks designed to (1) prevent generation of the radiation unless the chamber is sealed and (2) shut off such equipment if the door is opened.

7.7.3. Access Limitation. Acting as agents of the owning PDs and DDs, line managers and facility managers must ensure that the operational supervisor controls access to regulated areas and must approve nonroutine entry of personnel into these places. Access can be limited by barriers, interlocks, administrative controls, and other controls. When practical, sources of RFMW radiation should be switched off when not in use. Generating equipment should be de-energized during maintenance operations.

7.7.4. Warning Signs. Signs commensurate with the RFMW level must be used to warn personnel of RFMW hazards. Approved warning signs are listed and described in the Laboratory "Sign Catalog." These signs must be posted on access panels of irradiated enclosures and at entrances to and inside regulated areas.

Contact ESH-5 for assistance in determining their placement.

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7.7 Control Measures (cont)

7.7.5. Shielding. Wire mesh shielding that encloses the radiating equipment or provides a barrier between the equipment and the worker may be used to protect personnel; however, the shielding design must account for the frequency and intensity of the field. Contact ESH-5 for assistance in designing and evaluating shielding.

7.7.6. Clothing and RF-Protective Suits and Eyewear. Everyday footwear and socks can modify the absorption of electromagnetic energy at frequencies less than 100 MHz. The degree of effectiveness can be determined by an induced current meter. In general, wool socks work better than nylon socks, and rubber-soled shoes work better than leather-soled shoes.

RF-protective suits and eyewear are not readily available and are not generally useful options as protection against RFMW radiation and fields.

ESH-5 must be contacted during the initial planning stages of an operation that may involve the use of RF-protective suits and eyewear for protection against RFMW radiation.

7.8 Measuring RFMW Radiation

Consult an ESH-5 industrial hygienist or the Nonionizing Radiation Section of the ESH-5 Field Operations Manual if you have any questions about how RFMW radiation is measured.

7.9 Exposure Standards

RFMW radiation from sources in the Laboratory should not exceed the limits shown in Attachment A. Ambient field strength and radio-frequency (rf)-current flow limits for controlled environments are specified in Table I; exposure limits for uncontrolled environments are specified in Table II. When rf-current flow measurements can be made, they will determine whether a hazard exists at the applicable frequencies (30 kHz–3 MHz); both ambient fields and rf-current flows are significant considerations between 3 MHz and 100 MHz. Higher exposure is permitted on parts of the body, as specified in Table III, if the whole-body average exposure still meets the limits in Tables I or II.

7.9 Exposure Standards (cont)

7.9.1. Partial-Body Exposures. When partial-body exposures exist, the MPE can be relaxed. Relaxation values for partial-body exposures are specified in Table III. Higher exposure is permitted provided the whole-body average exposure still meets the limits in Tables I and II.

7.9.2. Pulsed Fields. Many sources of RFMW energy produce pulsed-modulated fields. Contact ESH-5 for interpretation of pulsed-energy guidelines.

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8.0 Required Records

- 8.1
Line
Management**
- Line managers and facility managers must ensure that the following records are maintained.
- A current inventory of RFMW controlled areas, including sampling data for each area
 - Documents relevant to employee job-specific training
 - Copies of SOPs or SWPs involving RFMW fields
-

- 8.2
ESH-5**
- ESH-5 must maintain the following records.
- Copies of this Laboratory document
 - A comprehensive inventory of RFMW sources and controlled areas
 - Workplace and employee exposure-monitoring (sampling) records
 - Records of training conducted by ESH-5
-

- 8.3
ESH-2**
- ESH-2 must maintain medical surveillance records.
-

9.0 References

- 9.1
Documents**
- “Electromagnetic Fields, Safety Levels with Respect to Human Exposure to Radio Frequency,” IEEE C95.1 (Institute of Electrical and Electronics Engineers, 1991).
- “Environmental Protection, Safety, and Health Protection Standards,” Department of Energy Order 5480.4 (May 15, 1984).
- “Health Hazard Assessment Strategy for Hazard Evaluation,” Industrial Hygiene and Safety (ESH-5) internal procedure (most recent draft).
- “Lockout/Tagout for Control of Equipment and Systems Status (Blue Lock Procedure),” Los Alamos National Laboratory controlled document LP106-02.1 (or most recent edition) in *ES&H Program Documents*.
- “Lockout/Tagout for Control of Hazardous Energy Sources for Personnel Safety (Red Lock Procedure),” Los Alamos National Laboratory controlled document LP106-01.2 (or most recent edition) in *ES&H Program Documents*.
- “Personal Protective Equipment,” administrative requirement AR 12-1, in *Environment, Safety, and Health Manual*, Los Alamos National Laboratory Manual, Chapter 12 (most recent edition).
- “Radio-Frequency Radiation Hazard Warning Symbol,” ANSI C95.2 (American National Standards Institute, 1982).
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9.1 Documents (cont.)

“Sign Catalog,” a Laboratory on-line document under “Policies and Procedures.”

“Signs, Labels, and Tags,” Los Alamos National Laboratory controlled Laboratory implementation requirements document LIR402-400-01.0 (most recent edition).

The Industrial Environment, Its Evaluation & Control, NIOSH, Chapter 28
(National Institute of Occupational Safety and Health, 1973).

“Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment” (American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, most recent edition).

9.2 Referrals

Environment, Safety, and Health (ESH) Division, 7-4218

Industrial Hygiene and Safety Group (ESH-5), 7-5231

Occupational Medicine Group (ESH-2), 7-7251

9.3 Document Ownership

ESH-5, acting as an agent of the Laboratory, is responsible for the information in this document.

10.0 Attachments

A: RFMW Exposure Limits

B: Recommended Major Implementation Criteria for Self-Assessment

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Attachment A: RFMW Exposure Limits

Table I Controlled Environment Exposure Limits				
Part A: Electromagnetic Fields ^a				
1 Frequency Range (<i>f</i> , MHz)	2 Electric Field Strength (<i>E</i> , V/m)	3 Magnetic Field Strength (<i>H</i> , A/m)	4 Power Density <i>E</i> Field, <i>H</i> Field (<i>S</i> , mW/cm ²)	5 Averaging Time $ E ^2$, $ H ^2$ or <i>S</i> (minutes)
0.03–0.1	61.4	163	(100, 1,000,000) ^b	6
0.1–3.0	61.4	16.3/ <i>f</i>	(100, 10,000/ <i>f</i> ²) ^b	6
3–30	1842/ <i>f</i>	16.3/ <i>f</i>	(900/ <i>f</i> ² , 10,000/ <i>f</i> ²) ^b	6
30–100	61.4	16.3/ <i>f</i>	(1.0, 10,000/ <i>f</i> ²) ^b	6
100–300	61.4	0.163	1.0	6
300–3,000	—	—	<i>f</i> /300	6
3,000–15,000	—	—	10	6
15,000–300,000	—	—	10	616,000/ <i>f</i> ^{1.2}
Part B: Induced and Contact Radio-Frequency Currents ^c				
Frequency Range (<i>f</i> , MHz)	Maximum Current (mA)		Contact	
	Through both feet	Through each foot		
0.03–0.1	2,000 <i>f</i>	1,000 <i>f</i>	1,000 <i>f</i>	
0.1–100	200	100	100	

^a The exposure values in terms of electric and magnetic field strength are the values obtained by spatially averaging values over an area equivalent to the vertical cross section of the human body (projected area).

^b These plane-wave equivalent power density values, although not appropriate for near-field conditions, are commonly used as a convenient comparison with MPEs at higher frequencies and are displayed on some instruments.

^c It should be noted that the current limits given above may not adequately protect against startle reactions and burns caused by transient discharges when contacting an energized object.

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Table II				
Uncontrolled Environment Exposure Limits				
Part A: Electromagnetic Fields ^a				
1 Frequency Range (<i>f</i> , MHz)	2 Electric Field Strength (<i>E</i> , V/m)	3 Magnetic Field Strength (<i>H</i> , A/m)	4 Power Density <i>E</i> Field, <i>H</i> Field (<i>S</i> , mW/cm ²)	5 Averaging Time $ E ^2$, <i>S</i> or $ H ^2$ (minutes)
0.03–0.1	61.4	163	(100, 1,000,000) ^b	6 6
0.1–1.34	61.4	16.3/ <i>f</i>	(100, 10,000/ <i>f</i> ²) ^b	6 6
1.34–3.0	823.8/ <i>f</i>	16.3/ <i>f</i>	(180/ <i>f</i> ² , 10,000/ <i>f</i> ²) ^b	<i>f</i> ² /0.3 6
3.0–30	823.8/ <i>f</i>	16.3/ <i>f</i>	(180/ <i>f</i> ² , 10,000/ <i>f</i> ²) ^b	30 6
30–100	27.5	158.3/ <i>f</i> ^{1.668}	(0.2, 940,000/ <i>f</i> ^{6.336}) ^b	30 0.0636 <i>f</i> ^{1.337}
100–300	27.5	0.0729	0.2	30 30
300–3,000	—	—	<i>f</i> /1,500	30
3,000–15,000	—	—	<i>f</i> /1,500	90,000/ <i>f</i>
15,000–300,000	—	—	10	616,000/ <i>f</i> ^{1.2}
Part B: Induced and Contact Radio-Frequency Currents ^c				
Frequency Range (<i>f</i> , MHz)	Maximum Current (mA)		Contact	
	Through both feet	Through each foot		
0.03–0.1	900 <i>f</i>	450 <i>f</i>	450 <i>f</i>	
0.1–100	90	45	45	

^a The exposure values in terms of electric and magnetic field strength are the values obtained by spatially averaging values over an area equivalent to the vertical cross section of the human body (projected area).

^b These plane-wave equivalent power density values, although not appropriate for near-field conditions, are commonly used as a convenient comparison with MPEs at higher frequency and are displayed on some instruments in use.

^c It should be noted that the current limits given above may not adequately protect against startle reactions caused by transient discharges when contacting an energized object.

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Table III			
Relaxation Values for Partial Body Exposures ^a			
	Frequency (f , GHz)	Peak Value of Mean Squared Field	Equivalent Power Density (mW/cm ²)
Controlled Environment	$0.0001 \leq f < 0.3$	$< 20E^2$ or $20H^2$ ^b	—
	$0.3 < f \leq 6$	—	< 20
	$6 < f \leq 96$	—	$< 20 (f/6)^{1/4}$ ^d
	$96 < f \leq 300$	—	40
Uncontrolled Environment	$0.0001 \leq f < 0.3$	$\leq 20E^2$ or $20H^2$ ^c	—
	$0.3 < f \leq 6$	—	4
	$6 < f \leq 30$	—	$f/1.5$ ^d
	$30 < f \leq 300$	—	20

^a These relaxation values *do not* apply to the eyes and testes.

^b E and H are the spatially averaged values from Table I.

^c E and H are the spatially averaged values from Table II.

^d f in GHz

Note: At frequencies between 0.03 and 0.1 MHz, the SAR exclusion rule, which determines the relaxation values given in Table III, does not apply. The MPE can only be exceeded in this range if it can be shown that the peak RMS current density does not exceed $35f$ in mA/cm², where f is the frequency in MHz.

Guidance

Attachment B

Recommended Major Implementation Criteria for Self-Assessment

(Non-Mandatory)	
LIR Title	LIR Number
Radio-Frequency and Microwave (RFMW) Radiation and Fields (30kHz to 300GHz)	LIR 402-400-02.0

The major implementation criteria listed below are provided to assist Laboratory organizations assess their implementation of this LIR. These criteria provide an objective basis for self-assessing implementation of the major requirements contained in the LIR. The LIR also states requirements in other areas, such as, scope, precautions, and responsibilities that, when applied, complement the successful implementation of these major requirements.

- 1. The most important criterion for assessing the implementation status of this LIR should be, if applicable: Have the requirements contained in the LIR been communicated to the individual(s) responsible for performing the work?**
- 2. In addition, the recommended major implementation criteria for self-assessment of this LIR are the following:**
 - Written instruction and procedures identify hazards and controls for using
 - permanently installed RFMW gear capable of radiating over 1 W into an open area at frequencies between 30 kHz and 300 GHz or of emitting over 100 W if the output is normally completely enclosed by coaxial cables, waveguides, or dummy or real loads;
 - all satellite and permanently installed communications transmitters (not receivers);
 - portable walkie-talkie communications sets capable of radiating over 7 W at frequencies between 100 kHz and 450 MHz, and over 7 (450/f) W at frequencies between 450 MHz and 1.0 GHz (f in MHz); and
 - all induction heaters. (Microwave ovens used as a household appliance, cellular phones, video display terminals and radar speed guns are exempt.)
 - All above non-exempt equipment and associated principal equipment users are registered in the ESH-5 NIR database.
 - All registered equipment is evaluated by a qualified individual to determine radiation and field levels and personnel exposures, if deemed necessary, and opinions/measurement data entered in the ESH-5 NIR database.
 - Personnel are not exposed to radiation and field strength levels from the above non-exempt equipment greater than those given in the LIR exposure limit tables.